



527 CMR 33

Understanding how Process Safety Management
applies to your facility

Overview

- What is PSM?
- When does it apply?
- Where to start?
 - Collect process information
 - Assemble applicable codes & standards
- How to perform a Hazard Review

What does Process Safety Management(PSM) mean?

- Making sure we “keep it in the pipe”
- Series of steps:
 - Identify Hazards
 - Identify Consequences
 - Identify Safeguards
 - Close the gaps
 - Maintain Safeguards (maintenance, training, incident analysis, etc.)
 - Manage Change
 - Document!

Are you processing a Hazardous Substance?

- Hazards:
 - Flammable Gases
 - Class 1 Flammable Liquids
 - Flammable Solid
 - Pyrophoric
 - Oxidizer (including organic peroxides)
 - Reactive (including water reactive)
 - Toxic or highly toxic
 - Corrosive
- Listed:
 - OSHA PSM Appendix A (29 CFR 1901.119)
 - EPA 40 CFR part 68

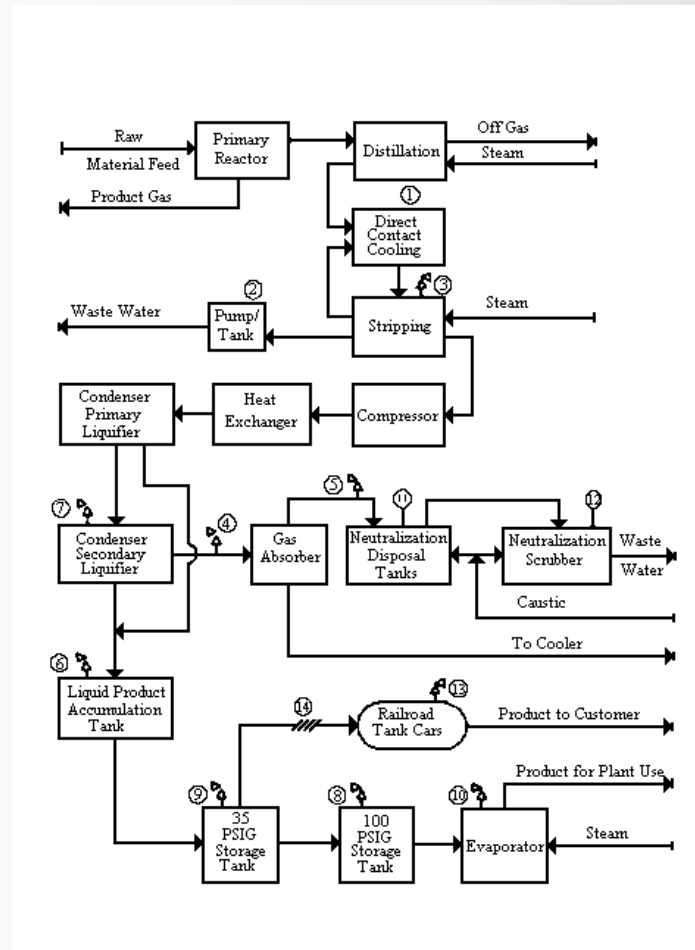
How do we get started?

- Collect process information:
 - MSDS
 - Chemistry (including upper and lower operating limits)
 - Process Flow Diagrams (Mass & Energy Balances)
 - Materials of Construction
 - Procedures
 - Training Records
 - Safety Systems
 - Emergency Response
 - P&ID's (Category 4)

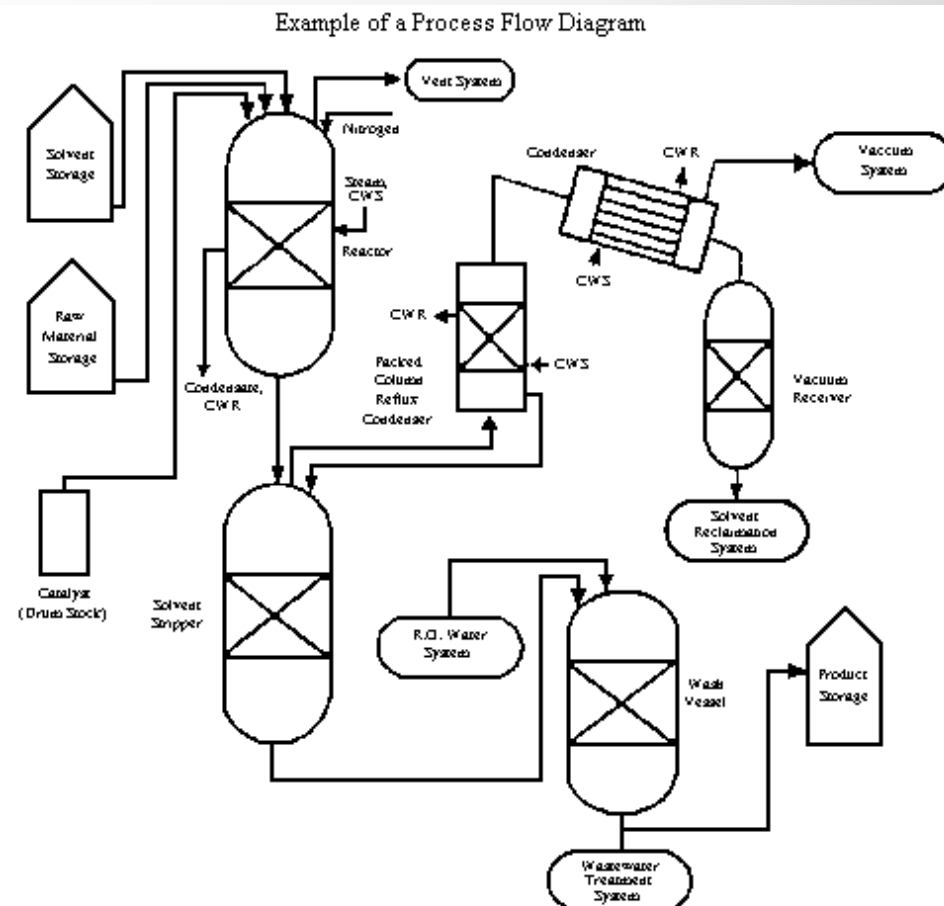
Have you met all applicable codes & standards?

- Building Code
- Fire Code
- Electrical Code
- OSHA Standards
- CGA Standards
- DEP requirements

APPENDIX B to §1910.119 -- Block Flow Diagram



APPENDIX B to §1910.119 -- Simplified Process Flow Diagram



Example of Piping and Instrumentation Diagram (P&ID)

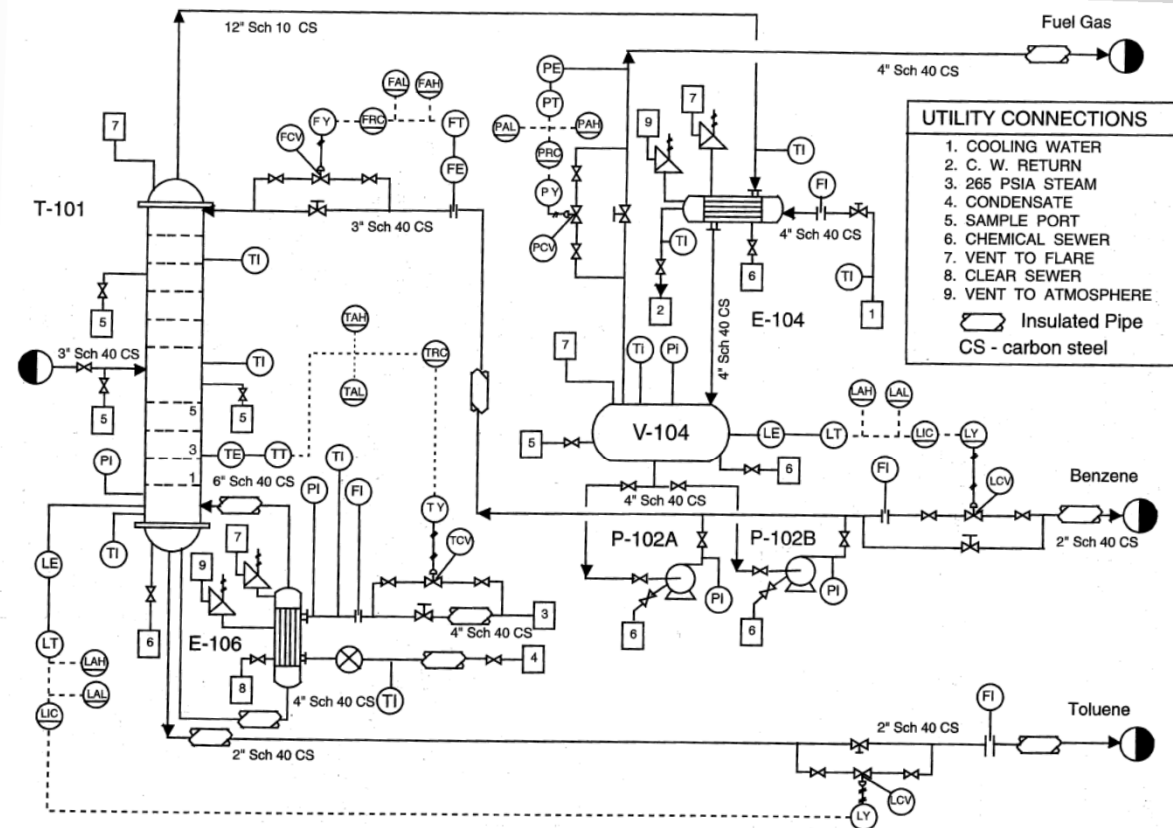


Figure 1.7 Piping and Instrumentation Diagram for Benzene Distillation (adapted from Kauffman, D, "Flow Sheets and Diagrams," AIChE Modular Instruction, Series G: Design of Equipment, series editor J. Beckman, AIChE, New York, 1986, vol 1, Chapter G.1.5, AIChE copyright © 1986 AIChE, all rights reserved)

Conduct the Hazard Review

- Methodology dependent on level of hazard:
 - Checklist
 - What if?
 - HAZOP
- Assemble Team:
 - Operations
 - Maintenance
 - Instrumentation and Controls
 - Knowledgeable Professional(s)
 - “Cold-eye”
 - Facilitator

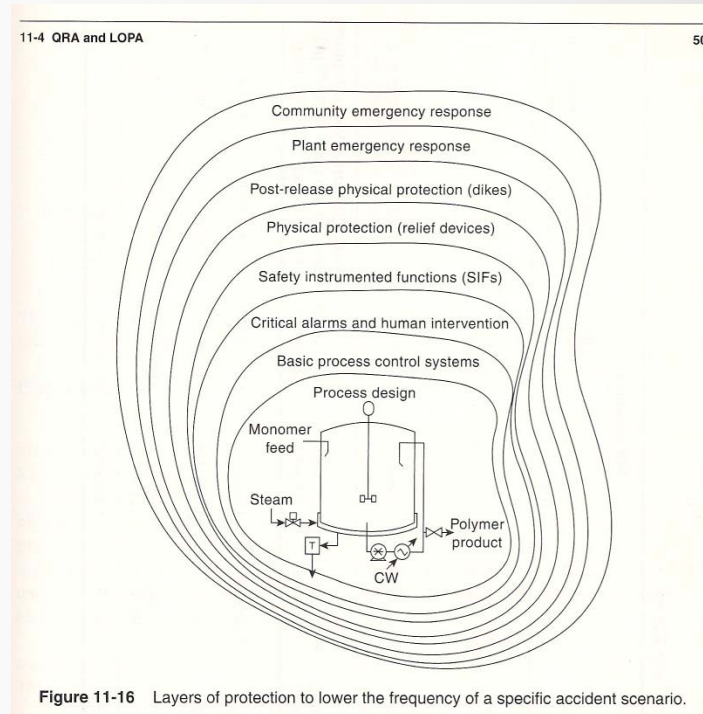
Identify Potential Hazards and Assign Tasks

- Does the potential hazard warrant an action?
- Are there systems in place already?
- Can we implement simple solutions?
- Are there multiple solutions?
- Do we need to perform a quantitative risk analysis?

Quantitative Risk Assessment

- Many tools available
- Consequence Analysis
 - Dispersion Modeling
 - Explosion Modeling
- Probabilistic Risk Assessment
 - Fault Tree
 - Layer of Protection
 - Common Mode Failure
 - Human Reliability

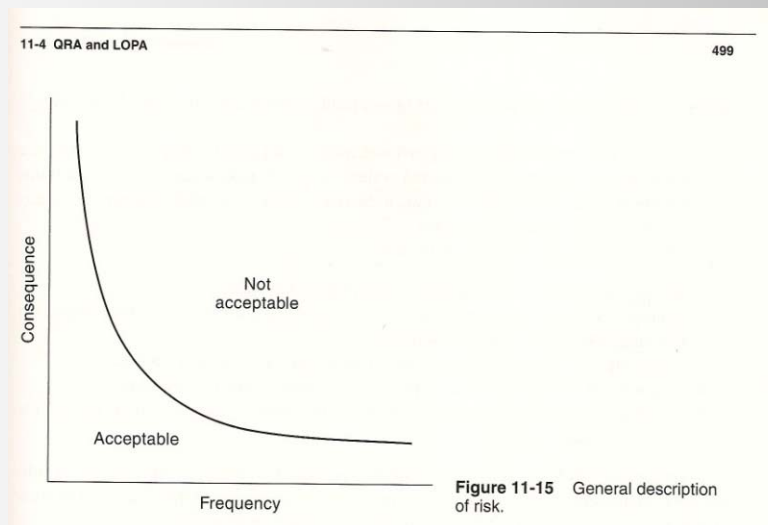
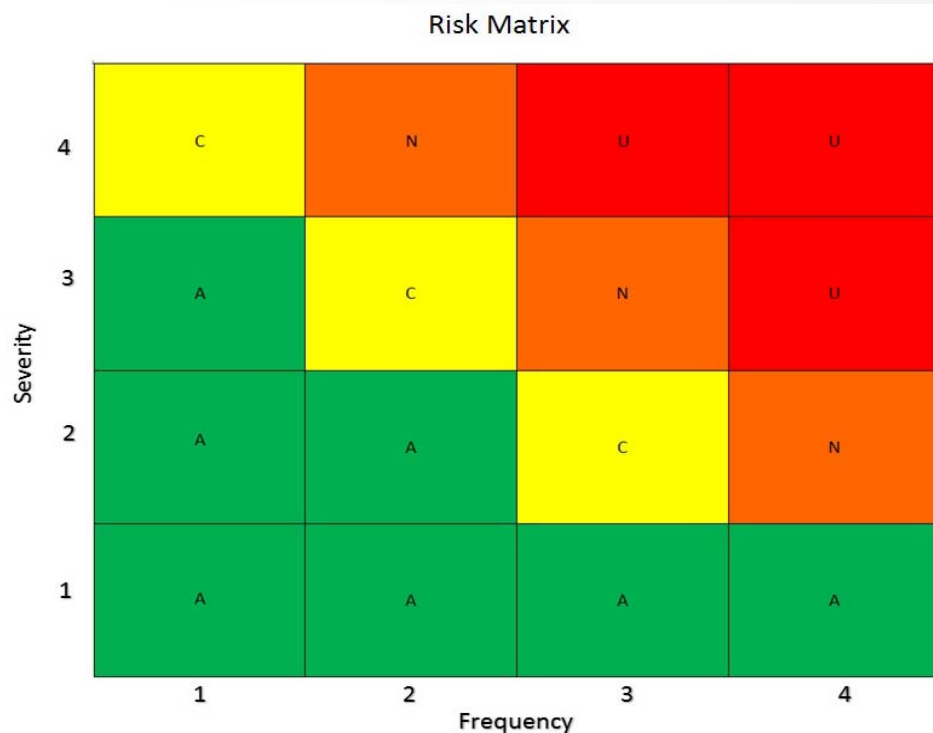
Layers of Protection for a Chemical Facility



How do you quantify risk?

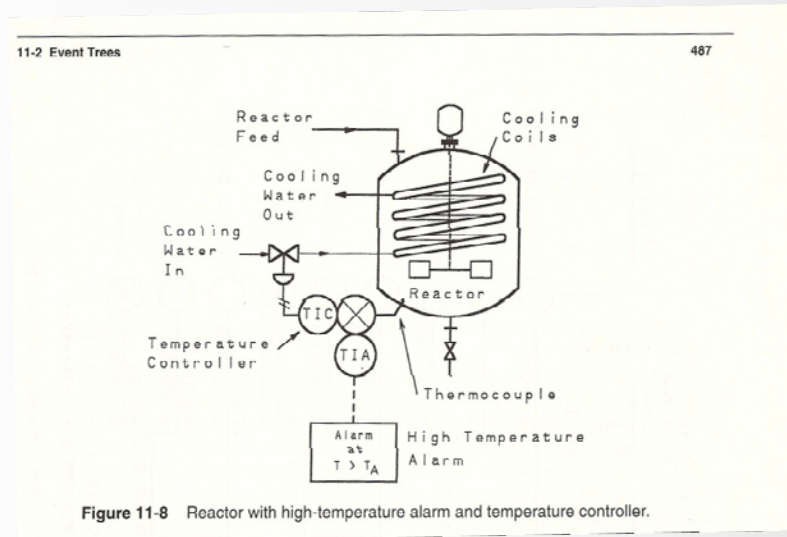
Conceptually:

(Crowl & Louvar, Chemical Process Safety, 2nd ed.)



Risk Ranking	Description
A	Acceptable – No risk control measures are needed
C	Acceptable with control – Risk control measures are in place
N	Not Desirable – Risk control measures to be introduced within a specified time period
U	Unacceptable

Consider a simple polymerization reactor:



Fault Tree Analysis shows a probability of runaway once every 40 years with manual response only, however:

Adding an high temperature interlock to shut off reactor feed reduces the probability to once every 400 years.

Maintain Safeguards

- Need to reduce Probability of Failure on Demand (PFD) to very low levels
- Maintenance
- Inspection
- Testing
- Mechanical Integrity Program (if warranted)
- Training
- Review Incidents and make improvements
- **Management of Change**

Resources

- OSHA PSM (publications 3132 and 3133)
- Center for Chemical Process Safety (CCPS) at www.aiche.org
- Chemical Safety Board (CSB) www.csb.gov
- PHA Consultants:
 - Chilworth
 - Primatech
 - AcuTech
 - ABS Consulting
 - Quest Consultants
- Textbook: Crowl & Louvar, Chemical Process Safety, 3rd ed., Prentice Hall, 2011

Thank you

- If you have further questions, please contact us at info@spec-eng.com
- Download this presentation at: www.spec-eng.com